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A Kinetic and Kinematic Analysis of The Rear Foot Elevated Split Squat 5RM Test

Mark Helme, Dr Stacey Emmonds, Dr Chris Low¹

¹ Institute of Sport, Physical activity and Leisure, Carnegie School of Sport.

Introduction

The rear foot elevated split squat (RFESS) is a multi-joint, unilateral resistance exercise, commonly used in strength and conditioning (McCurdy, 2017). McCurdy, Langford et al. (2004) and McCurdy and Langford (2005) have previously reported the RFESS as a reliable measure of unilateral leg strength (1RM ICC, 0.97- 0.99). The aim of this study was to firstly quantify the kinetic and kinematic characteristics of the RFESS 5RM test protocol. Secondly to profile the intra-set differences between repetitions.

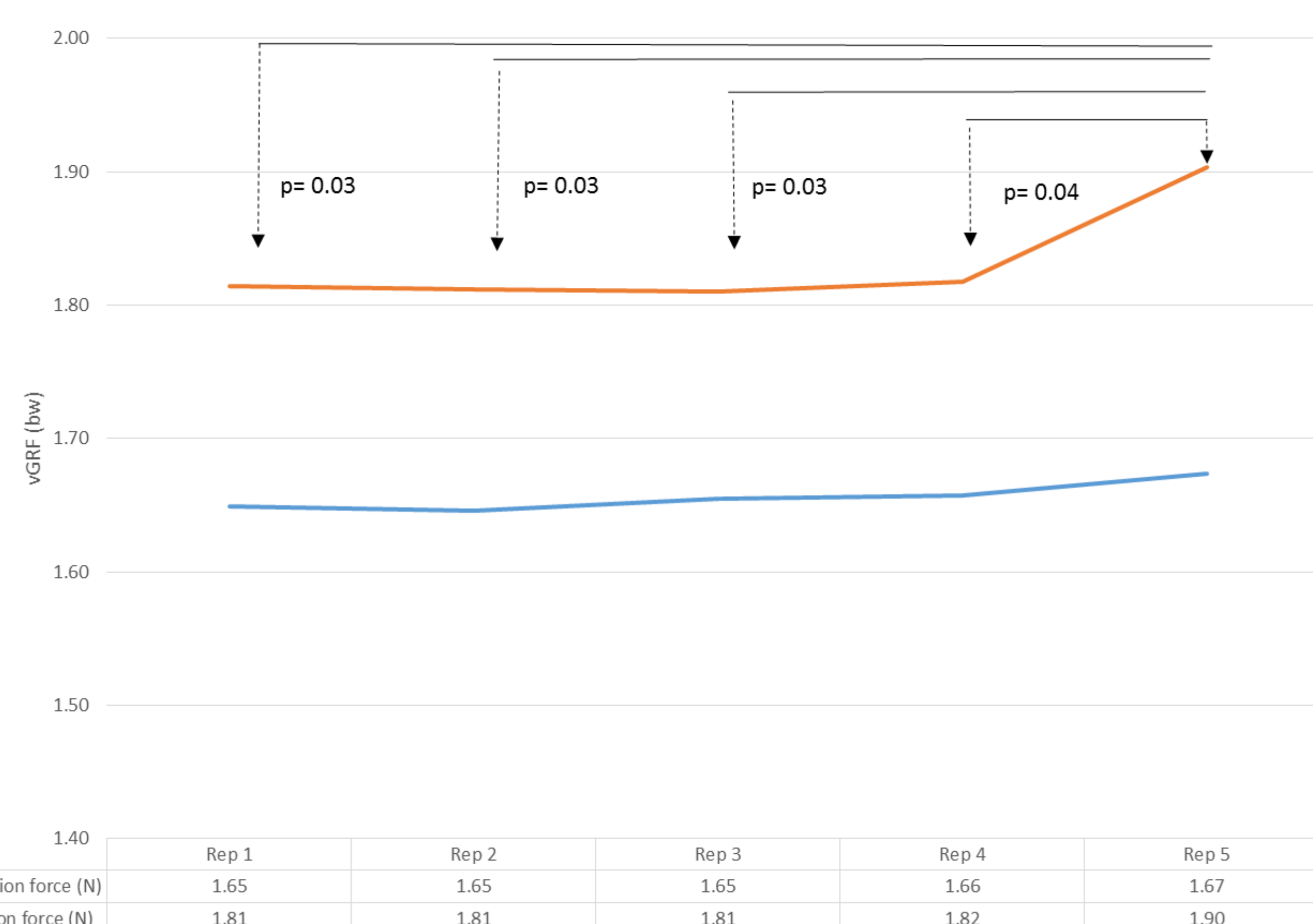
Methods

26 volunteers were recruited, (age = 23.8 ± 4.6 years, mass = 88.1 ± 10.7 kg, height = 1.79 ± 0.1 m), all subjects were engaged in a structured strength and conditioning program. Participants were required to undergo an incremental loading test until maximal load was achieved.

Kinetic data was collected from the front and rear foot through two independent Kistler 9827C force plates at 1000Hz (Kistler Group, Winterthur, Switzerland), as depicted in figure 1. Kinematic data was captured through Qualysis Track Manager System at 250Hz (Qualysis AB, Gothenburg, Sweden) using 10 cameras (six ceiling mounted and four, floor mounted).



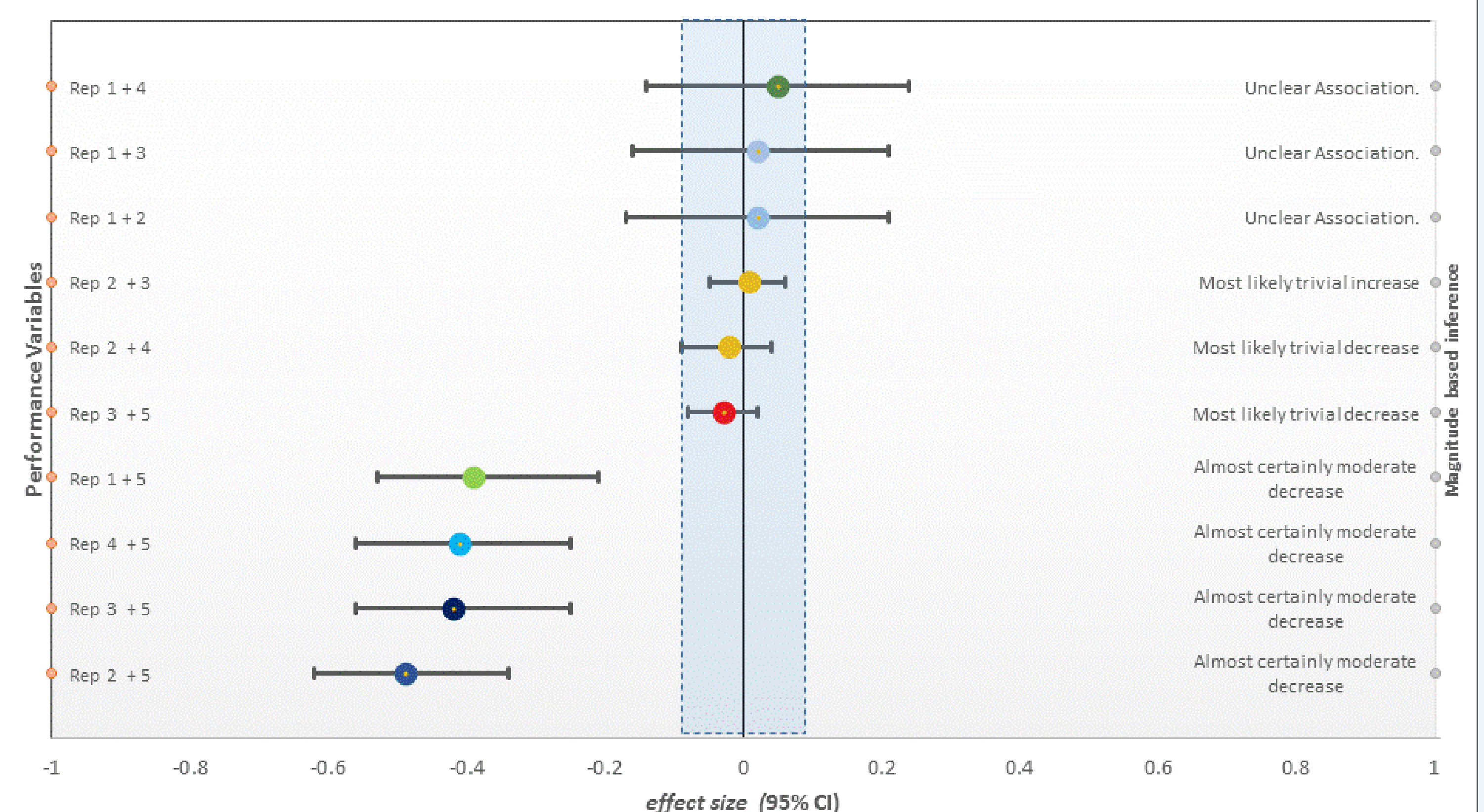
Comparison of the mean and peak concentric vertical ground reaction forces, relative to body weight, within a RFESS 5RM



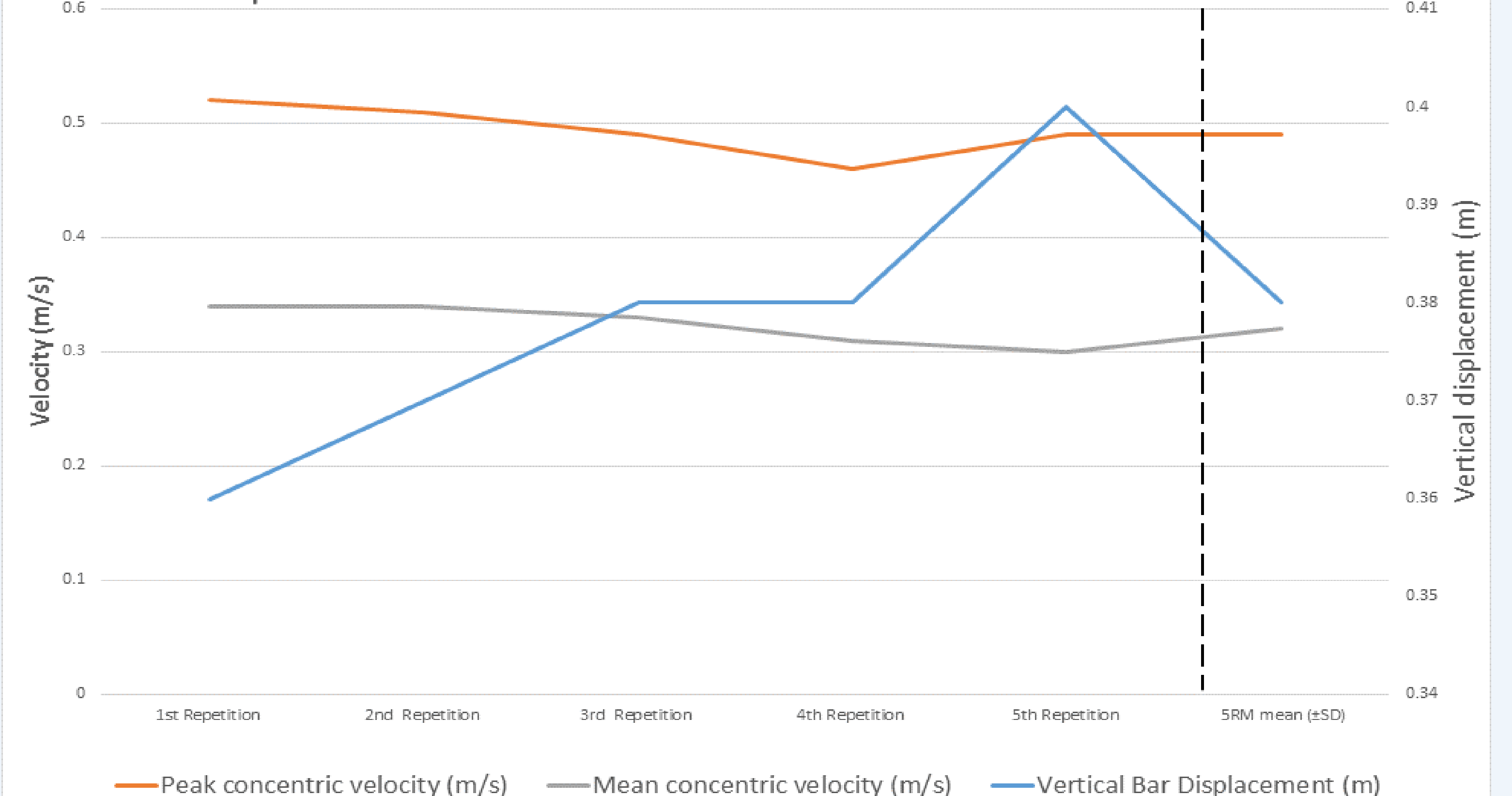
RESULTS

The mean load lifted was $84\text{kg} \pm 16.8\text{kg}$ (0.96 ± 0.18 kg/kg). The mean vertical displacement of the bar was $0.38 \pm 0.06\text{m}$, mean concentric velocity was $0.32 \pm 0.05\text{m/s}$ and peak concentric velocity was $0.49 \pm 0.11\text{m/s}$. The mean vertical ground reaction force (vGRF) of the lead foot was $1432.54 \pm 200.87\text{N}$, ($1.66 \pm 0.20\text{BW}$). The lead foot produced $83.53 \pm 4.03\%$ of total vGRF. There were unclear differences in all kinetic variables between all repetitions, except for peak (vGRF) of the lead foot only ($1.90 \pm 0.28\text{BW}$) of Repetition 5, which was very likely larger. Repetitions 1 and 2 were likely to very likely to have higher

Comparison of effect sizes, in differences of vGRF, relative to body weight, within a RFESS 5RM



Comparison of kinematic variables within a RFESS 5RM test



Conclusion:

The RFESS 5RM is valid and reliable method of measuring unilateral leg strength. A multi-repetition protocol can be used to determine maximal strength, yet intra-set differences may not exist prior to completion of the final repetition. It is recommended that the mean of the repetitions is taken when summarising the kinematic and kinetic variables in a multi repetition test.